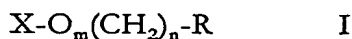


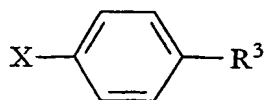
## Claims

1. An ionic dopant comprising a sulfur or a phosphorus containing anion with a random cation, for use in a smectic A liquid crystal composition, wherein the dopant is capable of reducing the driving voltage of the smectic A liquid crystal device and enhancing dynamic light scattering.
2. An ionic dopant as claimed in claim 1, wherein the sulfur or phosphorus containing anion comprises X, and X is one of the following S<sup>-</sup>, SO<sub>2</sub><sup>-</sup>, SO<sub>3</sub><sup>-</sup>, SO<sub>4</sub><sup>-</sup>, NHSO<sub>3</sub><sup>-</sup>, POH<sup>-</sup>, PO<sub>2</sub>H<sup>-</sup>, PO<sub>3</sub>H<sup>-</sup>, (PO<sub>3</sub>)<sup>2-</sup>, PO<sub>4</sub>H<sup>-</sup> or (PO<sub>4</sub>)<sup>2-</sup>.
3. An ionic dopant as claimed in either of the preceding claims, wherein the anion is according to formula I:



wherein X is S<sup>-</sup>, SO<sub>2</sub><sup>-</sup>, SO<sub>3</sub><sup>-</sup>, NHSO<sub>3</sub><sup>-</sup>, POH<sup>-</sup>, PO<sub>2</sub>H<sup>-</sup>, PO<sub>3</sub>H<sup>-</sup> or (PO<sub>3</sub>)<sup>2-</sup>; m is 0 or 1; n is 0 to 19; and R is R<sup>3</sup>, R<sup>1</sup>R<sup>3</sup>, R<sup>1</sup>-(CO<sub>2</sub>)-R<sup>3</sup>, R<sup>1</sup>-(CO<sub>2</sub>)-R<sup>2</sup>R<sup>3</sup>, R<sup>1</sup>-(CH<sub>2</sub>)<sub>p</sub>-R<sup>3</sup>, or R<sup>1</sup>-(CH<sub>2</sub>)<sub>p</sub>-R<sup>2</sup>R<sup>3</sup>, wherein R<sup>1</sup> is a phenyl, a substituted phenyl, a biphenyl, a substituted biphenyl, a terphenyl, a substituted terphenyl, an aromatic ring, a non-aromatic ring, a cyclohexyl, a cyclopentyl, a diazine, a bidiazine, a terdiazine, a phenyldiazine, a biphenyldiazine, a naphthalene or an azanaphthalene; R<sup>2</sup> is a phenyl, a substituted phenyl, a biphenyl, a substituted biphenyl, a terphenyl, a substituted terphenyl, an aromatic ring, a non-aromatic ring, a cyclohexyl, a cyclopentyl, a diazine, a bidiazine, a terdiazine, a phenyldiazine, a biphenyldiazine, a naphthalene or an azanaphthalene; R<sup>3</sup> is a hydrogen, a cyano group, an alkyl chain, an alkyl substituted cyclohexyl, an alkenyl chain, an alkyl chain wherein one or more non-adjacent CH<sub>2</sub>-groups are replaced by an oxygen atom; and p is 0 to 19.

4. An ionic dopant as claimed in claim 3, wherein the anion comprises:



wherein X is  $\text{SO}_3^-$ ,  $(\text{PO}_3\text{H})^-$ ,  $\text{PO}_3^{2-}$ , and  $\text{R}^3$  is an alkyl or alkoxy chain.

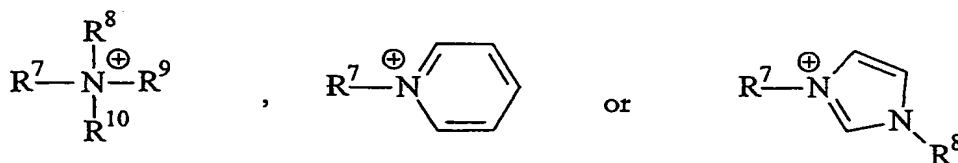
5. An ionic dopant as claimed in claim 1, wherein the anion is chiral.
6. An ionic dopant comprising a quaternary ammonium cation with an anion, for use in a smectic A liquid crystal composition, wherein the dopant is capable of reducing the driving voltage of the smectic A liquid crystal device and enhancing dynamic light scattering.
7. An ionic dopant as claimed in any one of claims 1-4, wherein the cation is a quaternary ammonium cation.
8. An ionic dopant as claimed in any one of the preceding claims, wherein the cation is based on a heterocyclic base.
9. An ionic dopant as claimed in claim 7, wherein the cation is based on an N-alkylpyridine, an N-N'-dialkylimidazole, an N-N'-dialkylbenzimidazole, an N-N'-dialkyltriazole, an N-alkylquinuclidine or an N-alkylazanaphthalene.
10. An ionic dopant as claimed in any one of the preceding claims, wherein the cation is according to formula II:



wherein Y is  $\text{NR}^4\text{R}^5\text{R}^6$  wherein  $\text{R}^4$ ,  $\text{R}^5$  and  $\text{R}^6$  is in every instance an alkyl group or an alkyl chain containing 0 to 5 carbon atoms, pyridines, N-alkylimidazoles, N-alkylbenzimidazoles, N-alkyltriazoles, alkylquinuclidines or alkylazanaphthalenes, q is 0 to 19; and R is  $\text{R}^3$ ,  $\text{R}^1\text{R}^3$ ,  $\text{R}^1-(\text{CO}_2)-\text{R}^3$ ,  $\text{R}^1-(\text{CO}_2)-\text{R}^2\text{R}^3$ ,  $\text{R}^1-(\text{CH}_2)_p-\text{R}^3$ , or  $\text{R}^1-(\text{CH}_2)_p-\text{R}^2\text{R}^3$ , wherein  $\text{R}^1$  is a phenyl, a substituted phenyl, a biphenyl, a substituted biphenyl, a terphenyl, a

substituted terphenyl, an aromatic ring, a non-aromatic ring, a cyclohexyl, a cyclopentyl, a diazine, a bidiazine, a terdiazine, a phenyldiazine, a biphenyldiazine, a naphthalene or an azanaphthalene; R<sup>2</sup> is a phenyl, a substituted phenyl, a biphenyl, a substituted biphenyl, a terphenyl, a substituted terphenyl, an aromatic ring, a non-aromatic ring, a cyclohexyl, a cyclopentyl, a diazine, a bidiazine, a terdiazine, a phenyldiazine, a biphenyldiazine, a naphthalene or an azanaphthalene; R<sup>3</sup> is a hydrogen, a cyano group, an alkyl chain, an alkyl substituted cyclohexyl, an alkenyl chain, an alkyl chain wherein one or more non-adjacent CH<sub>2</sub>-groups are replaced by an oxygen atom; and p is 0 to 19.

11. An ionic dopant as claimed in any one of the preceding claims, wherein the cation is:

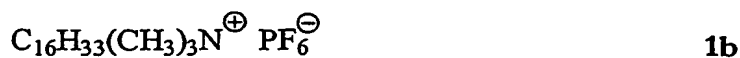


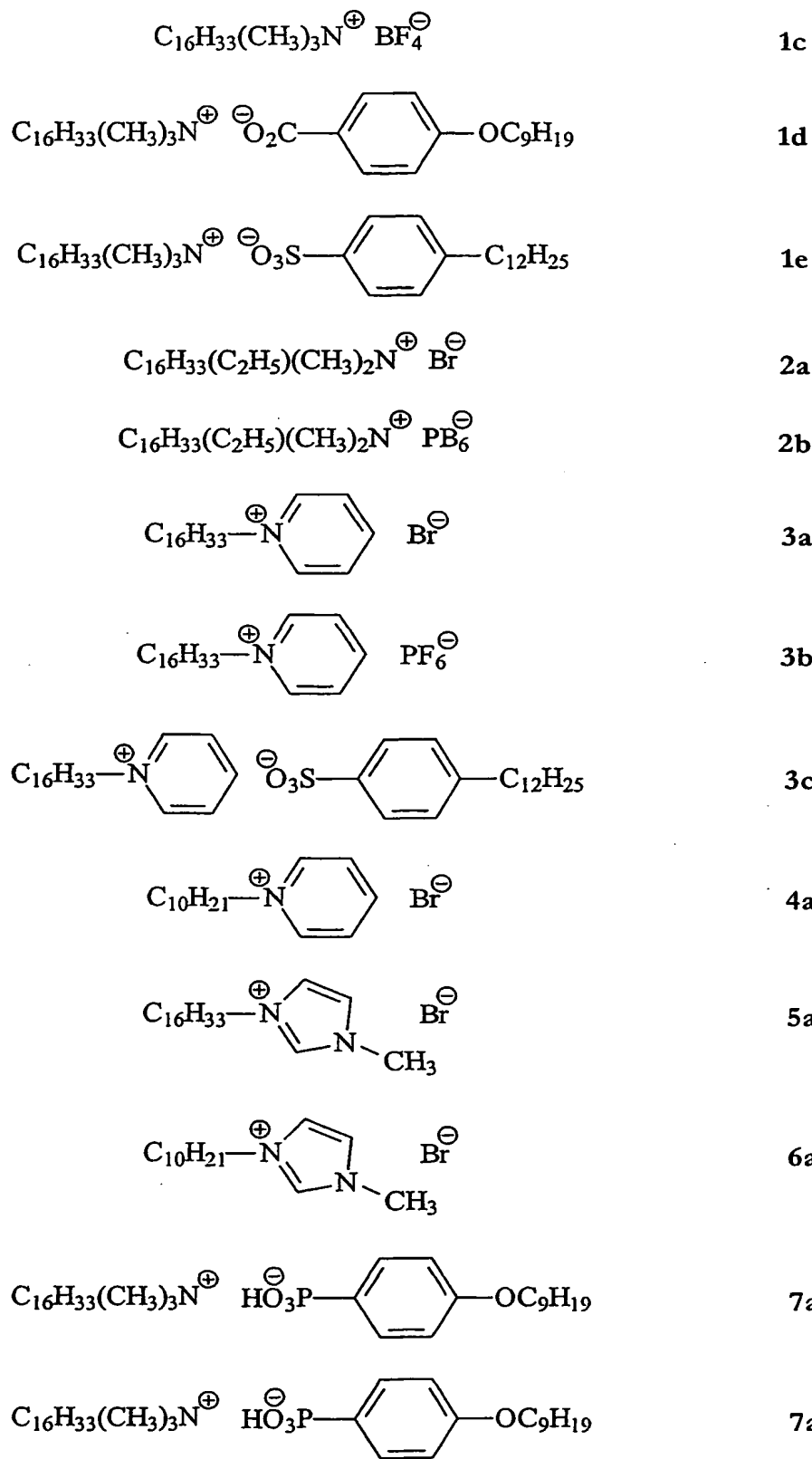
where R<sup>7</sup>, R<sup>8</sup>, R<sup>9</sup> and R<sup>10</sup> are alkyl chains.

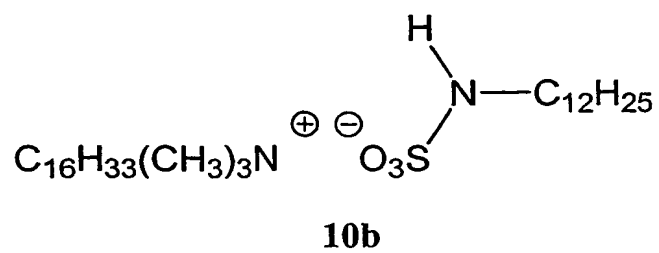
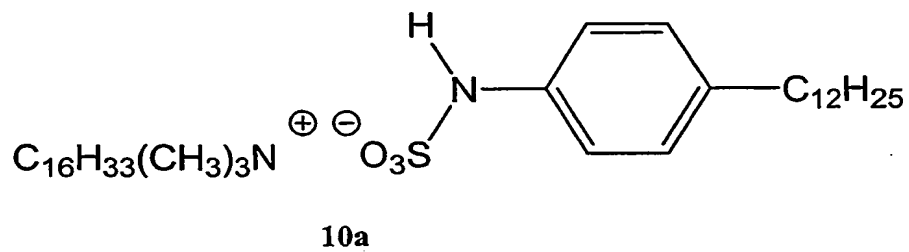
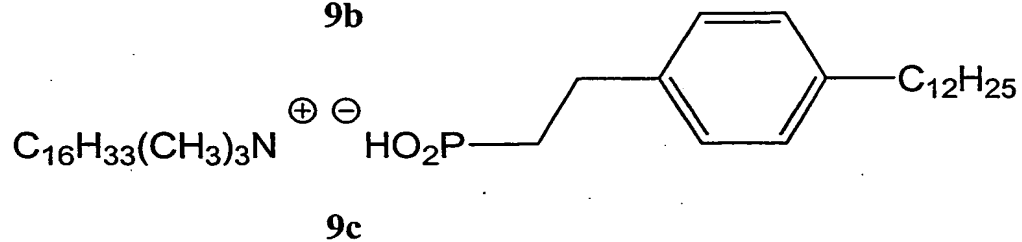
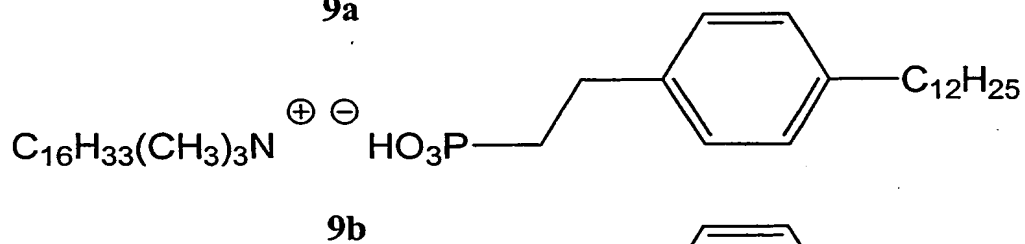
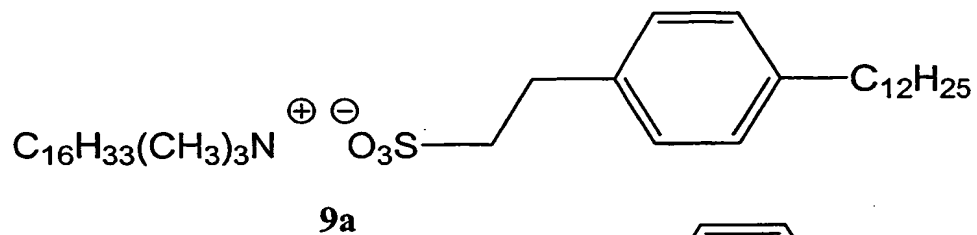
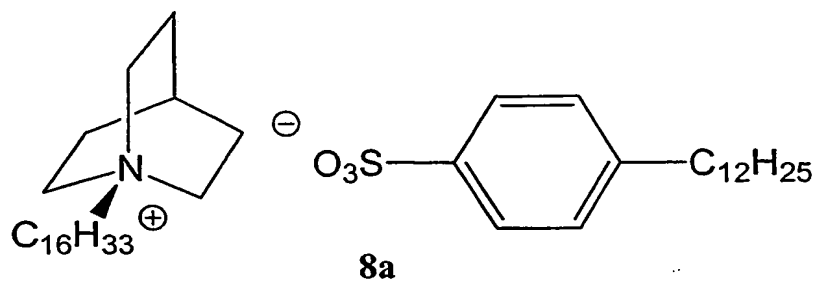
12. An ionic dopant as claimed in any one of the preceding claims, wherein the cation is *n*-hexadecyltrimethylammonium (HTMA) or *n*-hexadecyldimethylethylammonium (HDME).

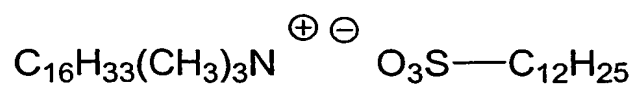
13. An ionic dopant as claimed in claim 7, wherein the cation is chiral.

14. An ionic dopant as claimed in any one of the preceding claims, wherein the dopant is:









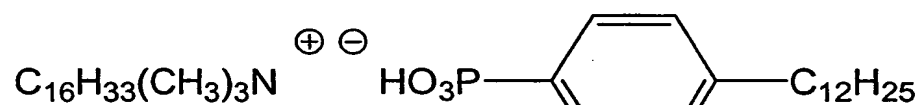
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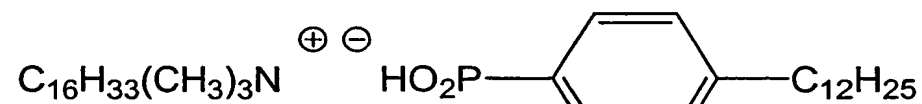
11b



11c



11d



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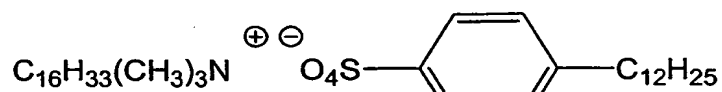
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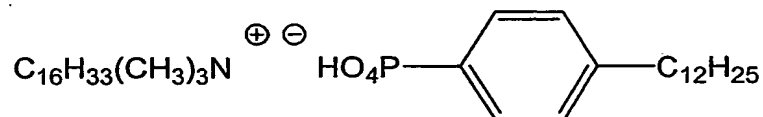
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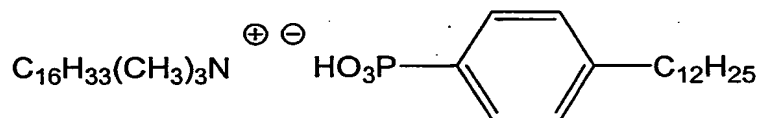
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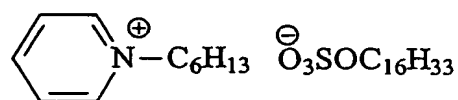
12d



12e



12f



13a

- 5 15. A smectic A liquid crystal composition comprising one or more ionic dopants as claimed in any one of the preceding claims.
16. A device containing a smectic A liquid crystal composition as claimed in claim 15.

17. A device as claimed in claim 16, wherein the device is a display or a light shutter.
18. A method of doping a smectic A liquid crystal composition, by adding an ionic dopant as claimed in any one of claims 1-14 to a smectic A liquid crystal composition.